

## TITLE OF THE INVENTION

### INFORMATION STORAGE MEDIUM AND METHOD OF RECORDING/REPRODUCING THE SAME

## CROSS-REFERENCE TO RELATED APPLICATION

**[0001]** This application claims the benefit of Korean Patent Application No. 2002-78167, filed on December 10, 2002 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

**[0002]** The present invention relates to an information storage medium having user data areas and additional data areas and a method of reproducing information recorded on the information storage medium, and more particularly, to an information storage medium having an improved structure in which user data areas are distinguished from additional data areas and a method of recording information thereon and/or reproducing information from the information storage medium.

### 2. Description of the Related Art

**[0003]** Optical discs are generally used as information storage media of optical pickup devices which record information on and/or reproduce information from the optical discs without contacting the optical discs. Optical discs are classified as either compact discs (CDs) or digital versatile discs (DVDs) according to their information recording capacity. Optical discs can also be classified as either recordable discs or read-only discs according to their recording potential. Here, the recordable discs include 650MB CD-Rs, CD-RWs, 4.7GB DVD+R/RWs, DVD-random access memories (DVD-RAMs), DVD-R/rewritables (DVD-R/RWs), and so forth. The read-only discs include 650MB CDs, 4.7GB DVD-ROMs, and the like.

**[0004]** FIG. 1 illustrates the data structure of a recordable information storage medium such as a CD-R or a CD-RW. Referring to FIG. 1, the recordable information storage medium includes user data areas A and additional data areas B located before and after the user data areas A. Here, the user data areas A are physical clusters in which data is recorded. The additional data areas B are divided into run-in areas and run-out areas.

**[0005]** The additional data areas B serve as spare areas in which data can be recorded even when a recording position of the information storage medium is changed with a variation in the speed of a spindle motor during rotating of the information storage medium on a turntable.

**[0006]** In a case where a read-only information storage medium is manufactured according to the above-described format, the read-only information storage medium is required to have the same structure as the recordable information storage medium so as to have reproduction compatibility in a drive and a format consistent with the recordable information storage medium. In other words, the read-only information storage medium has a structure including user data areas A and additional data areas B. Here, the additional data areas B are located before and after the user data areas A and must have the same length as the run-in areas and the run-out areas described with reference to FIG. 1. In this case, the additional data areas B have to be separated from the user data areas A.

#### SUMMARY OF THE INVENTION

**[0007]** Additional aspects and advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

**[0008]** The present invention provides an information storage medium having user data areas and additional data areas, and sync patterns to distinguish the additional data areas from the user data areas, and a method of recording information on and/or reproducing information from the same.

**[0009]** According to an aspect of the present invention, an information storage medium includes a user data area in which user data is recorded and an additional data area located in at least one of areas before and after the user data area, where second sync patterns used in the additional data area are different from first sync patterns used in the user data area.

**[0010]** According to another aspect of the present invention, a method of recording information on and/or reproducing information from an information storage medium includes preparing user data area in which user data is recorded and an additional data area located in at least one of areas before and after the user data area, where second sync patterns used in

the additional data area are formed differently from first sync patterns used in the user data area.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0011]** These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates the data structure of a conventional recordable information storage medium such as a CD-R or a CD-RW;

FIG. 2 illustrates the data structure of a recording unit of an information storage medium according to an embodiment of the present invention;

FIG. 3 illustrates the data structure of the information storage medium; and

FIG. 4 is a block diagram of a recording and/or reproducing apparatus according to an embodiment of the present invention.

## DETAILED DESCRIPTION OF THE EMBODIMENTS

**[0012]** Reference will now be made in detail to the present embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

**[0013]** Referring to FIGs. 2 and 3, an information storage medium according to an embodiment of the present invention includes user data areas C in which user data is recorded and additional data areas D located before and/or after the user data areas C. The information storage medium may be a recordable information storage medium or a read-only information storage medium.

**[0014]** Each of the user data areas C contains a plurality of user data 11 separated by a plurality of first sync patterns 13. According to an aspect of the invention, the user data areas C include error correcting code (ECC) recording units.

**[0015]** Each of the additional data areas D contains a plurality of additional data 21 separated by a plurality of second sync patterns 23. Here, as will be explained later, the first sync patterns 13 have modulation codes corresponding to sync numbers shown in Tables 1 and

2 and are formed by combining predetermined selected sync numbers. The second sync patterns 23 are formed of predetermined type of patterns denoted by reference numerals 23a and 23b according to the same method as the plurality of first sync patterns 13.

**[0016]** According to an aspect of the invention, the second sync patterns 23 are different from the first sync patterns 13. In other words, the second sync patterns 23 are formed of patterns which are not used as the first sync patterns 13. By forming the second sync patterns 23 to be different from the first sync patterns 13, a reproducing system such as that shown in FIG. 4 can manage the additional data areas D by being able to differentiate the additional data areas D, with certainty, from the user data areas C.

**[0017]** The number of second sync patterns 23 depends on the length of the additional data areas D. It is preferable, but not required, that the second sync patterns 23 are arranged at equal intervals in order to increase an effective additional data efficiency of the additional data areas D. In addition, sync data can be easily restored during reproducing.

**[0018]** While not required, according to an aspect of the invention, the size of each of the plurality of user data 11 in the user data areas C is equal to a size of each of the plurality of additional data 21 in the additional data areas D. This structure can be realized by adjusting the positions of the second sync patterns 23.

**[0019]** It is preferable, but not required, that the entire size of additional data 21 in the additional data areas D be integer multiples of the size  $d_1$  of user data 11 recorded between two adjacent first sync patterns 13a and 13b. In other words, referring to FIG. 2, the size  $d_2$  of additional data 21 recorded between two adjacent second sync patterns 23a and 23b is equal to the size  $d_1$  of the user data 11 recorded between first sync patterns 13a, 13b, and the additional data 21 are recorded in two parts of each of the additional data areas D. Thus, the total size of the additional data 21 is an integer multiple of (i.e., is twice the size of) the size  $d_1$  of the user data 11. As a result, since sync signals are detected at regular intervals in all areas during reproducing of data, it is advantageous to restore the sync signals.

**[0020]** The structure of the information storage medium using a run-length-limited (RLL) ( $d$ ,  $k$ ) code will be described below. The RLL code indicates how many bits of value "0" exist between two bits of value "1". Thus, the RLL ( $d$ ,  $k$ ) code represents that the minimum number  $d$  and the maximum number  $k$  of bits of value "0" between two bits of value "1", respectively.

**[0021]** In the structure using the RLL (d, K) code, the first sync patterns 13 generally include sync bodies that do not satisfy the RLL (d, k) code and sync identifications (IDs) that satisfy the RLL (d, k) code. In other words, the sync bodies have a run length  $k + i$  when  $i$  is an integer that is greater than or equal to "1". The sync IDs contain different patterns to distinguish N different sync patterns.

**[0022]** The second sync patterns 23 include sync bodies that do not satisfy the RLL (d, k) code and sync IDs that satisfy the RLL (d, k) code. Here, the sync IDs contain different patterns to distinguish N different sync patterns.

**[0023]** FIG. 3 illustrates an embodiment of the data structure of an information storage medium including additional data areas D each having two additional data frames. Sync bodies and sync IDs of the information storage medium having the above data structure are shown in Tables 1 and 2 below.

**[0024]** As can be seen in Table 1, a RLL (1,7) code is used. Each sync body has 18 bits, and each sync ID has 6 bits. The user data area C includes 9 user data frames for sync data, and the additional data area D includes two user data frames for sync data.

Table 1

Sync No.	18-Bit Sync Body	6-Bit Sync ID	Remark
0	001 001 010 000 000 010	000 001	User Data Area Sync Data
1	001 001 010 000 000 010	010 010	
2	001 001 010 000 000 010	101 000	
3	001 001 010 000 000 010	100 001	
4	001 001 010 000 000 010	000 100	
5	001 001 010 000 000 010	001 001	
6	001 001 010 000 000 010	010 101	
7	001 001 010 000 000 010	010 000	
8	001 001 010 000 000 010	101 010	
9	001 001 010 000 000 010	100 101	Additional Data Area Sync Data
10	001 001 010 000 000 010	101 001	

**[0025]** As can be seen in Table 2, a RLL (2,10) code is used. Each sync body has 22 bits, and each sync ID has 10 bits. The user data area C includes 7 user data frames for sync data, and the additional data area D includes 2 user data frames for sync data.

Table 2

Sync No.	22-Bit Sync Body	10-Bit Sync ID	Remark
0	100 001 000 000 000 000 010 0	010 001 000 1	User Data Area Sync Data
1	100 001 000 000 000 000 010 0	000 100 100 1	
2	100 001 000 000 000 000 010 0	010 000 010 0	
3	100 001 000 000 000 000 010 0	001 000 000 0	
4	100 001 000 000 000 000 010 0	100 100 100 0	
5	100 001 000 000 000 000 010 0	010 000 100 0	
6	100 001 000 000 000 000 010 0	000 010 000 0	
7	100 001 000 000 000 000 010 0	010 001 000 1	Additional Data Area Sync Data
8	100 001 000 000 000 000 010 0	010 010 010 0	

**[0026]** As shown in Tables 1 and 2, the sync data in the additional data D area has different patterns as compared to the sync data in the user data area C. In other words, the sync IDs of the second sync patterns 23 have sync patterns not used as the first sync patterns 13. Therefore, the additional data areas D can be managed and can be distinctly differentiated from the user data areas C.

**[0027]** A method of recording information on and/or reproducing information from the information storage medium having the above-described structure will be described. As shown in FIG. 2, the user data areas C including basic ECC recording blocks and the additional data areas D located before and/or after the user data areas C are prepared in the information storage medium. Next, the second sync patterns 23 used in the additional data areas D are formed differently from the first sync patterns 13 used in the user data areas C.

**[0028]** Here, the second sync patterns 23 are plural and arranged at equal intervals. It is preferable, but not required, that the second sync patterns 23 are arranged in the additional data areas D so that the size of each of user data 11 in the user data areas C is equal to the size of each of additional data 21 in the additional data areas D.

**[0029]** Sync data in the additional data areas D contains sync bodies having second sync patterns that do not comply with the RLL (d, k) code and sync IDs having second sync patterns that comply with the RLL (d, k) code. The total size of additional data 21 in the additional data areas D is an integer multiple of the size of user data 11 recorded between two first sync patterns 13a and 13 b.

**[0030]** As described above, an information storage medium and a method of recording information thereon and/or reproducing information therefrom according to the present invention can maintain consistency with the formats of different types of recordable information storage media and have reproduction compatibility in a drive.

**[0031]** Also, since sync patterns used in user data areas can be formed differently from sync patterns used in additional data areas, the additional data areas can be further efficiently separated from the user data areas.

**[0032]** Furthermore, by uniformly maintaining the length of data recorded in the user data areas and the additional data areas, sync signals can be detected at regular intervals in all areas during reproducing of data. Thus, it is advantageous to restore the sync signals.

**[0033]** While not specifically so limited, it is understood that the information storage medium can include the CD-Rs, CD-RWs, DVD-RWs, DVD-RAMs, DVD+RWs, as well as next generation high definition DVDs, such as Blu-ray discs, Advanced Optical Discs (AODs) and other optical storage media not listed above and/or to be developed.

**[0034]** FIG. 4 is a block diagram of a recording and/or reproducing apparatus according to an embodiment of the present invention. Referring to FIG. 4, the recording and/or reproducing apparatus includes a recording/reading unit 1001, a controller 1002, and a memory 1003. The recording/reading unit 1001 records data on a disc 1000, which is an embodiment of an information storage medium of the present invention, and reads the data from the disc 1000. The controller 1002 records and reproduces the user data 11 and the additional data 21 according to the present invention as set forth above in relation to FIGs. 2 and 3.

**[0035]** While not required in all aspects, it is understood that the controller 1002 can be a computer implementing the method using a computer program encoded on a computer readable medium. The computer can be implemented as a chip having firmware, or can be a general or special purpose computer programmable to perform the method.

**[0036]** In addition, it is understood that, in order to achieve a recording capacity of several dozen gigabytes, the recording/reading unit 1001 could include a low wavelength, high numerical aperture type unit usable to record dozens of gigabytes of data on the disc 1000. Examples of such units include, but are not limited to, those units using light wavelengths of 405

nm and having numerical apertures of 0.85, those units compatible with Blu-ray discs, and/or those units compatible with Advanced Optical Discs (AOD).

**[0037]** While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims and equivalents thereof.